Simulation of Bio-medical Waveguide in Mechanical and Optical Fields

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Outline

- Introduction
- Structural design
- Comsol Simulation
- Conclusion
Introduction
Introduction
Anastomotic leakage is between 4% and 17 %

Table : Colonic surgery results

<table>
<thead>
<tr>
<th></th>
<th>Without leakage</th>
<th>With leakage</th>
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<tbody>
<tr>
<td>mortality</td>
<td>2.6%</td>
<td>18.6%</td>
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<tr>
<td>Organ failure</td>
<td>1.1%</td>
<td>15.9%</td>
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Introduction
Structural Design

Figure A: Schematic of the freestanding waveguide

Figure B: Cross section of the freestanding waveguide

Light source

Evanescent field region

Transmitted light

Drain fluid

Figure B:

\[
\begin{align*}
\text{TiO}_2 / \text{Al}_2 \text{O}_3 & \quad \text{Si} \\
\text{Hr} & \quad \text{W} \quad \text{Ht} \\
\text{Hs} & \quad \text{SiN} \\
\text{SiN/SiO}_2 & \quad \text{W}_1
\end{align*}
\]
Optical Simulation

Figure: Optical simulation on the cross section of the waveguide
Mechanical Simulation

Surface: von Mises stress (N/m²)

Figure: Structural stress induced by material inner stress
Multi-physics Simulation

Figure: Combination of optical and mechanical simulation

- Moving mesh

Only 0.04% of energy is lost due to the stress-induced deformation
**Conclusion:**

- Optical simulations indicate the evanescent wave is suitable for bio-medical application.

- Mechanical simulations show the mechanical stability of the waveguide.

- Multi-physics simulations demonstrate the feasibility of the free-standing optical waveguide.

- Based on these simulations, new devices will be designed and fabricated.
QUESTIONS?

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Thank you!